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Benchmarking Validations for Dust Mobilization Models of GASFLOW Code

EFDA Reference: TW5-TSS-SEA 3.5 D4

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Abstract

Benchmarking validations for dust mobilization models of GASFLOW code

The governing equations of particle transport are defined and solved in the computational fluid dynamics code of GASFLOW. The particle motion model is based on the discrete Lagrangian approach being applicable to model the dust mobilization in the dilute dust / gas mixture, which is being expected to exist in the vacuum vessel of the ITER. A particle turbulent dispersion model and models of particle / boundary interactions, like rebound / deposition and entrainment, are defined as well. The deterministic particle trajectories obtained by GASFLOW simulations are verified against analytical solutions in both Cartesian and cylindrical systems. The stochastic particle dispersions caused by the turbulence in gas flow are compared between light and heavy particles in straight and curved ducts. Green's function method is applied to develop a bunch of theoretical solutions about particle concentration distributions in advective flows with different source / boundary conditions. The analytical solutions supply benchmarking verifications of the particle model of GASFLOW. Finally a graphite dust dispersion experiment is simulated by using GASFLOW. The comparison between the computed dust cloud developing process and the experimental one manifests that the particle model can produce the dust mobilization both qualitatively and quantitatively.